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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/754,926	01/04/2001	Kie Y. Ahn	MI22-1533	3846

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EXAMINER	
KIELIN, ERIK J	
ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 02/27/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/754,926	AHN ET AL.	
	Examiner	Art Unit	
	Erik Kielin	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 October 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-15* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-15* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *04 January 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Election/Restrictions

1. Applicant's election of species group I, claims 1-15 in Paper No. 4 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Cancellation of the remaining claims, 16-29 is acknowledged.

Information Disclosure Statement

2. The information disclosure statement filed 8/6/01 fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because the some of the references have not been provided with dates in accordance with 37 CFR 1.98(b)(5). Also the MPEP 609 states,

> "Each publication must be identified by publisher, author (if any), title, relevant pages of the publication, and **date** and place of publication. The date of publication supplied must include at least the **month and year** of publication, except that **the year of publication (without the month) will be accepted if the applicant points out in the information disclosure statement that the year of publication is sufficiently earlier than the effective U.S. filing date and any foreign priority date so that the particular month of publication is not in issue**." (Emphasis added.)

The IDS has been placed in the application file, but only the references initialed by Examiner have been considered. Applicant is advised that the date of any re-submission of any item of information contained in this information disclosure statement or the submission of any missing element(s) will be the date of submission for purposes of determining compliance with the

requirements based on the time of filing the statement, including all certification requirements for statements under 37 CFR 1.97(e). See MPEP § 609 ¶ C(1).

Drawings

3. Figure 6 is objected to as failing to comply with 37 CFR 1.84(p)(4) because reference character "34" has been used to designate both a sidewall and a source/drain region. For consistency with the specification, it is believed that the source/drain region should be labeled "30." A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

4. The disclosure is objected to because of the following informalities:

on p. 2, line 6, remove the last occurrence of "of" for clarity; and

on p. 2, line 7, after "voltage" insert --of-- for clarity.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims **1**-2, 4-7 and **11**, 12 are rejected under 35 U.S.C. 102(b) as being anticipated by US 5,856,017 (**Matsuda** et al.).

Matsuda discloses a method of forming silicon-doped aluminum oxide as a gas barrier film on a plastic film substrate comprising the steps of

co-evaporating plural sources which may be SiO and Al_2O_3; and

depositing at least some of the evaporated oxides to form the silicon-doped aluminum oxide on the plastic substrate. (See Abstract; col. 6, line 66 to col. 7, line 54 – especially col. 7, lines 5-13. See also col. 3, line 53 to col. 4, line 24 – especially col. 4, lines 14-18)

Note that SiO target material is disclosed at col. 7, line 7, Al_2O_3 target is disclosed at col. 7, line 9 and that combination films containing aluminum and silicon oxides, i.e. silicon-doped aluminum oxide, is disclosed at col. 7, lines 10-13, line 42, and line 51.

Regarding claims 2 and 12, no flow of oxygen is required as indicated at col. 8, lines 1-4. Also, the deposition necessarily occurs in a chamber since low pressure is required (col. 7, last paragraph).

Regarding claims 4 and 6, thermal evaporation of the source materials using resistance heating, high frequency heating, or electron beam heating is disclosed at col. 7, lines 2-5.

Regarding claim 5, ion beam heating is disclosed at col. 7, line 1 as sputtering or ion plating, each of which use ion beams.

Regarding claim 7, since thermal evaporation indicated by electron beam heating, as noted above, the combination of thermal evaporation of SiO and electron beam evaporation of Al_2O_3 is disclosed.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims **1**-2, 4-8, 10, and **11**-13, 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 5,923,056 (**Lee** et al.) in view of the basic text of **Vossen and Kern**, Thin Film Processes II, Academic Press: Boston, 1991, pp. 80-81, 108-109, 113-115, 188, 200.

Regarding independent claims **1** and **11**, **Lee** discloses forming a variety of semiconductor devices including MOS, flash EPROM, capacitors, DRAMs, etcetera having a doped metal oxide, which may be a silicon-doped aluminum oxide (col. 1, line 66 to col. 2, line 10; col. 3, lines 19-40). An **example** is disclosed (cols. 5-6, "EXAMPLE 1") wherein the silicon-doped aluminum oxide is formed by sputtering from a target containing aluminum with 1% silicon using sputtering (i.e. co-evaporating silicon and aluminum) in a chamber having argon and oxygen wherein evaporation is generated by glow discharge plasma.

Lee does not disclose that specifically silicon monoxide and aluminum oxide are co-evaporated, but does expressly state that the doped metal oxide films may be formed using "a conventional deposition technique such as sputtering ..." (col. 2, lines 15-21).

The basic textbook of **Vossen and Kern** teaches conventional techniques for forming thin films including forming a mixed or alloy film using "two-source sputtering, with one source for one alloy component and the other source for the second component." (See p. 200, section entitled "*Targets.*") **Vossen and Kern** also teaches numerous examples of mixed films formed

using separate evaporative sources on p. 108-109, Table II. Sources for aluminum oxide (Al_2O_3) and SiO are also taught to be known on pp. 113-115, Table III as well as the composition of the vapor upon evaporation. Note also that even is SiO_2 is used as the evaporative source, that SiO is the main component of the vapor -- not SiO_2. So even if SiO_2 is thermally evaporated, SiO is the vapor species formed.

It would have been obvious to one of ordinary skill at the time of the invention to use a silicon monoxide source and an aluminum oxide source to form a silicon doped aluminum oxide film as a matter of design choice because it appears that the choice of SiO and Al_2O_3 sources are known and will result is the same silicon-doped aluminum oxide as that disclosed in **Lee**, and because **Lee** teaches "a conventional deposition technique such as sputtering" will work and because the use of separate sources to form a mixed or alloy layer is conventional, as taught by **Vossen and Kern**.

Applicant could overcome the rejection by providing evidence that the specific use of silicon monoxide and aluminum oxide provides unexpected results in the Si-doped aluminum oxide film relative to that source used in **Lee**. Presently there is no such evidence of record.

Regarding claims 2 and 12, the omission of O_2 is obvious since the oxygen component is already provided in the known SiO and Al_2O_3 sources. One of ordinary skill would be motivated to leave out the oxygen since it is already provided in the sources used.

Regarding claims 4, **Vossen and Kern** also teach thermal evaporative systems for SiO (silicon monoxide) at pp. 98-99, especially Fig. 9, are conventional. It would have been obvious to one of ordinary skill at the time of the invention to use thermal evaporation of SiO, as a matter

of design choice since **Lee** teaches conventional deposition methods apply and because **Vossen and Kern** teaches thermal evaporation specifically of SiO is conventional.

Regarding claims 5 and 6, **Vossen and Kern** teach that thermal evaporation is conventionally carried out using, *inter alia*, electron beams (guns) (pp. 80-81), and that ion beams are conventionally used for sputter deposition (p. 188). It would have been obvious to one of ordinary skill at the time of the invention to use electron beam or ion beam sputtering of Al_2O_3 by an electron beam, as a matter of design choice since **Lee** teaches conventional deposition methods apply and because **Vossen and Kern** teach that electron and ion beams are conventional for deposition of thin films.

Regarding claim 7, the specific combination of thermal evaporation of SiO and "one or both of electron gun evaporation and ion beam evaporation" of Al_2O_3 is also a matter of design choice for the reasons indicated above -- especially since electron gun is just an example of a thermal evaporation method, as taught by **Vossen and Kern**.

Regarding claims 8 and 13, **Lee** discloses the silicon substrate (col. 5, line 56).

Regarding claims 10 and 15, **Lee** discloses the "conductive material" (called the "gate 13" in Lee) on the deposited silicon-doped aluminum oxide (called "gate dielectric 18" in **Lee**). Note that silicon is semiconductive.

5. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Lee** in view of **Vossen and Kern** as applied to claim 1 above, and further in view of JP 60-167352 A **(Fujisada)**.

The prior art of **Lee** in view of **Vossen and Kern**, as explained above, teaches all of the features of the claims except for using a sapphire source for the aluminum oxide.

Fujisada teaches the benefits of preventing injurious impurities from being incorporated into sputter-deposited aluminum oxide films by using a sapphire target, specifically for use in semiconductor device applications. (See Abstract.)

It would have been obvious to one of ordinary skill at the time of the invention to use a sapphire source as the aluminum oxide source in the method of **Lee** in view of **Vossen and Kern** to prevent contamination of the deposited film, as taught by **Fujisada**.

6. Claims 9 and 14 rejected under 35 U.S.C. 103(a) as being unpatentable over **Lee** in view of **Vossen and Kern** as applied to claims **1** and **11** respectively, above, and further in view of **Wolf**, Silicon Processing for the VLSI Era, Vol. 1 : Process Technology, Lattice Press: Sunset Beach, CA 1986, p. 5.

Lee does not specifically state that the silicon substrate is "monocrystalline."

Wolf teaches that integrated circuits are formed on monocrystalline or "single crystal" silicon substrates (p. 5, first paragraph under section entitled "Manufacture of Single Crystal Silicon.")

It would have been obvious to one of ordinary skill at the time of the invention to use the notoriously well-known monocrystalline substrates, as **Wolf** teaches that monocrystalline is always used over other forms of silicon to enable sufficient carrier lifetime in semiconductor devices.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The article **Manchanda** et al. "Gate quality doped high K films for CMOS beyond 100 nm: 3-10 nm Al_2O_3 with low leakage and low interface states," IEDM 1998, 6-9 December 1998, pp. 605-608, discloses the use of silicon-doped aluminum oxide for semiconductor device applications.

US 6,300,202 B1 (**Hobbs** et al.) teaches the use of silicon-doped aluminum oxide for semiconductor device applications (col. 2, lines 48-65).

US 6,280,810 B1 (**Nakamura** et al.) teaches co-sputtering of, *inter alia*, SiO and Al_2O_3 to form protective films (col. 4, lines 49-64).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached at 703-306-2417. The fax phone numbers for the organization where this application or proceeding is assigned are 703-306-7722 for regular communications and 703-306-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-306-3431.

Erik Kielin

February 22, 2002